Logarithm Review

$$\log_x y = \frac{\log_a y}{\log_a x} \overset{e.g.}{=} \frac{\ln(y)}{\ln(x)}$$

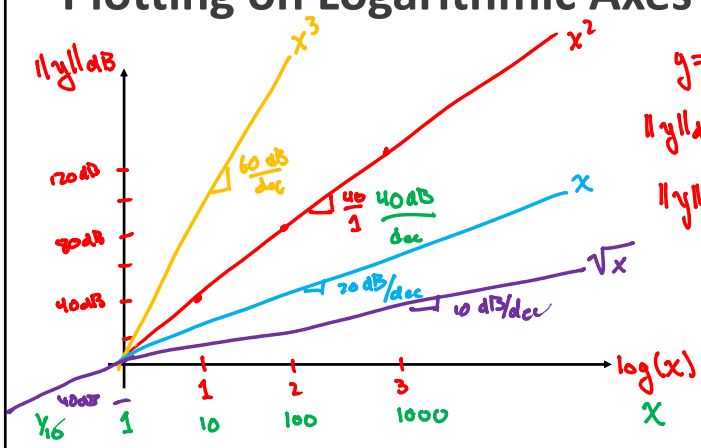
$$\log_{10} 5 = \frac{\ln(5)}{\ln(10)}$$

$$\log(x \cdot y) = \log(x) + \log(y)$$

$$\log(x/y) = \log(x) - \log(y)$$

$$\log(x^n) = n \log(x)$$

Plotting on Logarithmic Axes



$$y = x^2$$

$$\|y\|_{dB} = 20\log_{10}(\|x^2\|)$$

$$\|y\|_{dB} = 40 \log_{10}(x)$$

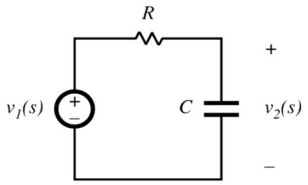
$$y_2 = x^3$$

$$\|y\|_{dB} = 60 \log(x)$$

$$x \to f$$

Plotting on Logarithmic Axes

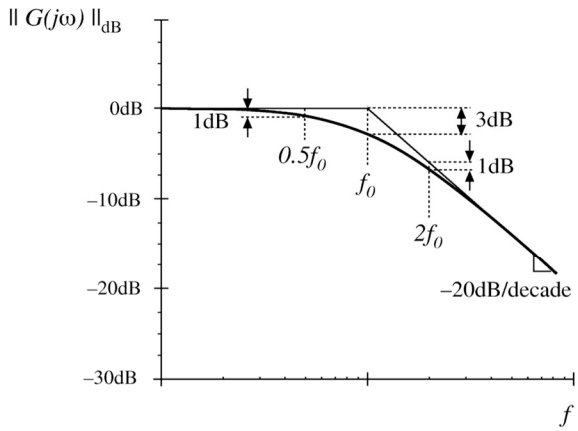
Single Pole Response



Magnitude of Single Pole Response

Plotting a Single Pole Response

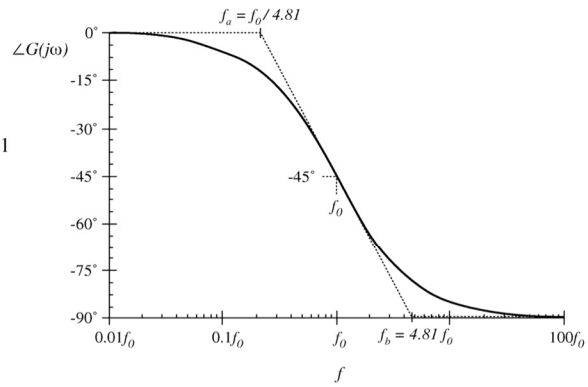
Summary: Single Pole Magnitude



Phase of Single Pole

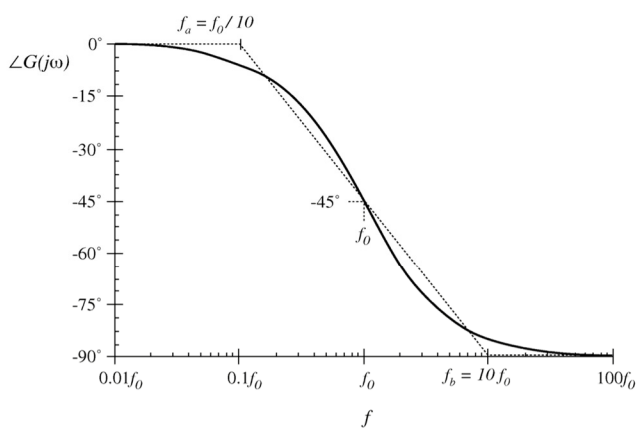
Phase Asymptotes

$f_a = f_0\, e^{-\pi/2} \approx f_0 / 4.81$
$f_b = f_0\, e^{\pi/2} \approx 4.81\, f_0$

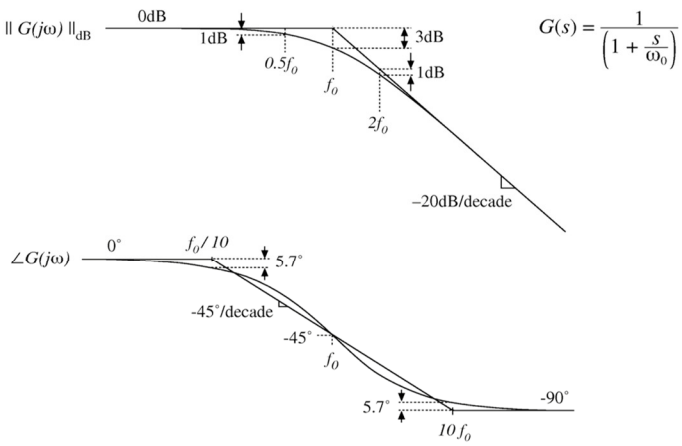


Phase Asymptotes: A Simpler Choice

$f_a = f_0 / 10$
$f_b = 10\, f_0$



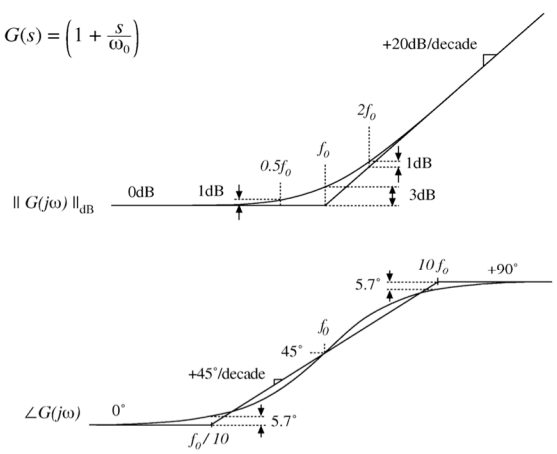
Summary: Single Real Pole



$$G(s) = \frac{1}{\left(1 + \frac{s}{\omega_0}\right)}$$

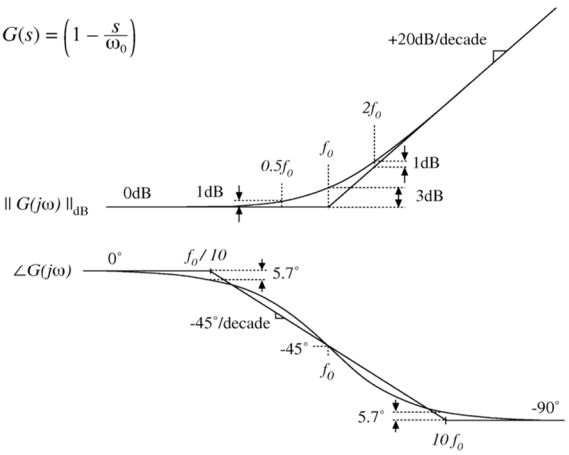
Bode Plot: Real Zero

$$G(s) = \left(1 + \frac{s}{\omega_0}\right)$$



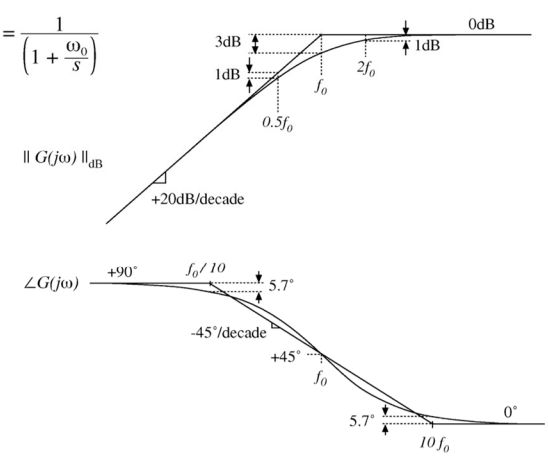
RHP Zero

$$G(s) = \left(1 - \frac{s}{\omega_0}\right)$$

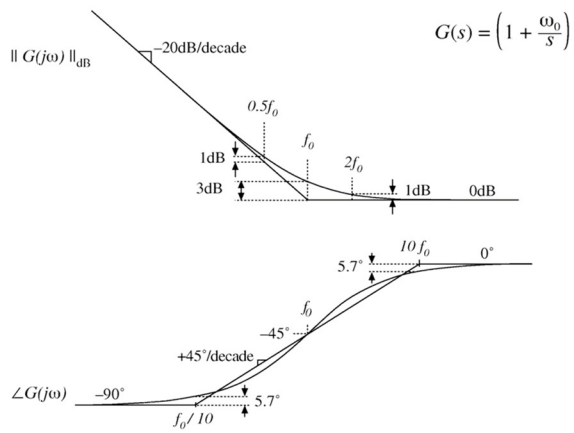


Inverted Pole

$$G(s) = \frac{1}{\left(1 + \frac{\omega_0}{s}\right)}$$



Inverted Zero



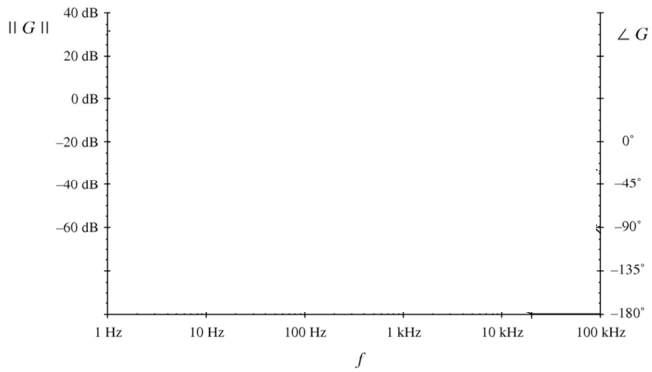
Fundamentals of Power Electronics 30 *Chapter 8: Converter Transfer Functions*

Multiplying Transfer Functions

Example 1

$$G(s) = \frac{G_0}{\left(1 + \frac{s}{\omega_1}\right)\left(1 + \frac{s}{\omega_2}\right)}$$

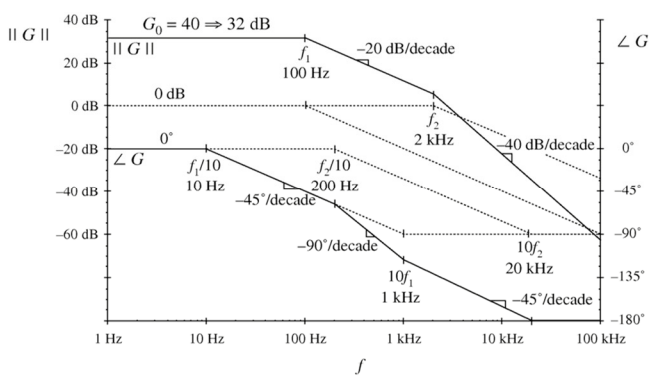
with $G_0 = 40 \Rightarrow 32$ dB, $f_1 = \omega_1/2\pi = 100$ Hz, $f_2 = \omega_2/2\pi = 2$ kHz



Example 1

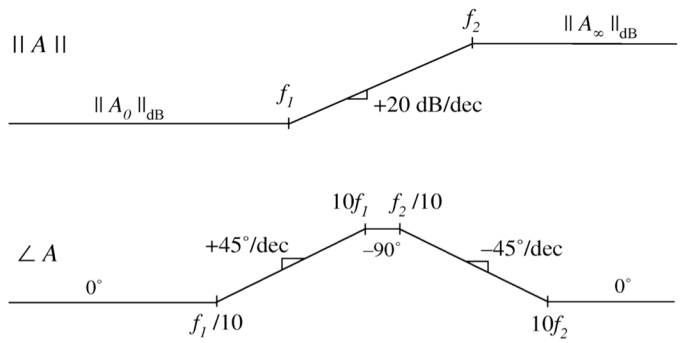
$$G(s) = \frac{G_0}{\left(1 + \frac{s}{\omega_1}\right)\left(1 + \frac{s}{\omega_2}\right)}$$

with $G_0 = 40 \Rightarrow 32$ dB, $f_1 = \omega_1/2\pi = 100$ Hz, $f_2 = \omega_2/2\pi = 2$ kHz



Example 2

Determine the transfer function $A(s)$ corresponding to the following asymptotes:



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